APPENDIX D
STATIC AND SEISMIC SLOPE STABILITY

This section describes procedures used to analyze the stability of the existing and proposed slopes under both the static and seismic conditions.

1 METHODS OF ANALYSIS

Stability was checked using the limit equilibrium procedure implemented in the following software packages

- XSTABL (v5.204), by Interactive Software Designs 1999
- SLIDE (v5.0) by RocScience, 2003

All analyses were conducted assuming Spencer's method for satisfying both force and moment equilibrium of the critical slip surface. Seismic (pseudostatic) analyses were performed by modeling the earthquake as a sustained horizontal force acting on the failure mass.

To perform pseudostatic analyses, a design-level earthquake was selected based on a recurrence interval of 475 years, which is the equivalent of a 10 percent probability that this event will occur in a 50-year time period. The USGS Earthquake Mapping Hazard Project has determined that an earthquake of this frequency would have a peak ground acceleration (PGA) of 0.23 g at the Holly Street Landfill site (USGS 2002). The PGA represents the peak acceleration that is anticipated for an earthquake of a given magnitude. For pseudostatic slope stability analyses, it is appropriate to use 50 percent of the PGA as an input horizontal force to model the average shaking that the soil mass will "feel" during an earthquake (Kramer 1996). Thus, seismic stability analyses employed a horizontal force of 0.115 g to the critical slip surface when computing factor of safety.

2 STABILITY OF SOUTH BANK AND ROCK BUTTRESS

Stability was checked for cross sections AA and BB, shown on sheets C-1 and C-3 of the plans. Section AA is slightly steeper than 2H:1V, and will be regraded with a thin fill sand and gravel buttress at the toe. Section BB is oversteepened and currently supported by a wooden bulkhead. The sand and gravel buttress will be up to about 10 feet thick in this area to provide the final grade of 2H:1V.

Assumed Soil and Sediment Properties

Sediment and soil strength, as modeled using a friction angle (ϕ), was selected using a combination of engineering judgment and experience, as well as by examining the blow count data and soil descriptions provided in the RI/FS for the Holly Street Landfill (Anchor, et. al., 2001). Copies of the boring logs and site plan are provided in Appendix A. Refuse engineering and strength parameters were compared to published research on this type of "soil" (Gabr and Valero, 1995). Table D-1 provides the assumed engineering and strength properties that were used in the slope stability model.

Table D-1
Soil and Sediment Properties for Stability Analyses

Soil Unit	Soil Description	Unit Weight (pcf]	Cohesion (c) (psf]	Friction Angle (ϕ) (degrees]
Fill	Sand (SP)	120	0	30
Refuse	Sandy Silt with debris (ML)	90	0	28
Alluvium	Silt with sand (ML)	90	0	26
Buttress Fill	Sand and Gravel	125	0	34

Conclusions of Analysis

Existing slope factors of safety (FOS) indicate marginal stability, with FOS ranging from 1.0 to 1.2 for the static condition. In areas, pseudostatic factors of safety are less than 1.0, which indicates that some sloughing may occur during a design-level earthquake. It is typically more cost-effective to plan on regrading slopes following an earthquake than it would be to take all steps necessary to design a slope that would resist the larger seismic events.

As mentioned previously, the sand and gravel fill will act as a berm, or "buttress" that will help stabilize the slope in the oversteepened areas where bulkheads are deteriorating. Because the depth of the existing bulkhead piles is not well-known, and due to the likely variability of shear strength in the solid waste, quantifying the exact FOS for the pile-reinforced slope is not feasible. However, in combination with the support provided by the existing piles, it is expected that the buttress will increase the existing factor of safety at least 40 to 50 percent for both the static and pseudostatic cases.

3 STABILITY OF EXCAVATION ADJACENT TO EXISTING RE-STORE BUILDING

Slope stability was evaluated to determine if regrading of the bank adjacent to the Re-store building would potentially affect the integrity of this structure. The Re-store building is located at the top of the bank within approximately five to 10 feet of the planned excavation. Few structural details were readily available regarding the design of the foundation of the building (i.e. pile supported or shallow footings), although it is known that the building has one basement level.

To conservatively model the surcharge load from the Re-Store building, it was assumed that the structure was founded on shallow footings with a maximum load of 2,000 psf at an elevation 10 feet below the existing grade. A pile-supported foundation would transfer loads even deeper than the assumed 10 feet below existing grade, which would result in minimal influence between the Re-Store Building and the adjacent regraded slope.

The minimum static factor of safety for circular slip surfaces passing beneath the Re-Store building was 3.22. The seismic factor of safety for the same critical slip surface was 2.10. Figure D-3 shows the location of the critical slip surface relative to the Re-Store Building. These factors of safety indicate that regrading of slopes adjacent to the Re-Store Building will not likely affect the stability of this structure's foundation.

4 STABILITY OF CONSTRUCTION SURCHARGE LOADS

It is specified that construction surcharge loads be maintained a minimum of 5 feet back from the top of the bank. Slope stability was evaluated for a surcharge representing a soil stockpile with a maximum load of 1,500 psf, which represents a stockpile approximately 12 feet high adjacent to the bank.

The minimum static factor of safety was determined to be 1.35 for a stockpile located 5 feet from the top of the bank, as shown in Figure D-4. The seismic factor of safety was not evaluated because the stockpile represents a temporary condition that will only occur for a short duration during construction. The factor of safety for this condition is adequate for short-term loading conditions, particularly considering the low likelihood that stockpiles of this height would be required during construction.

REFERENCES

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Kramer, S.L., "Geotechnical Earthquake Engineering," Prentice-Hall, Inc., 1996.

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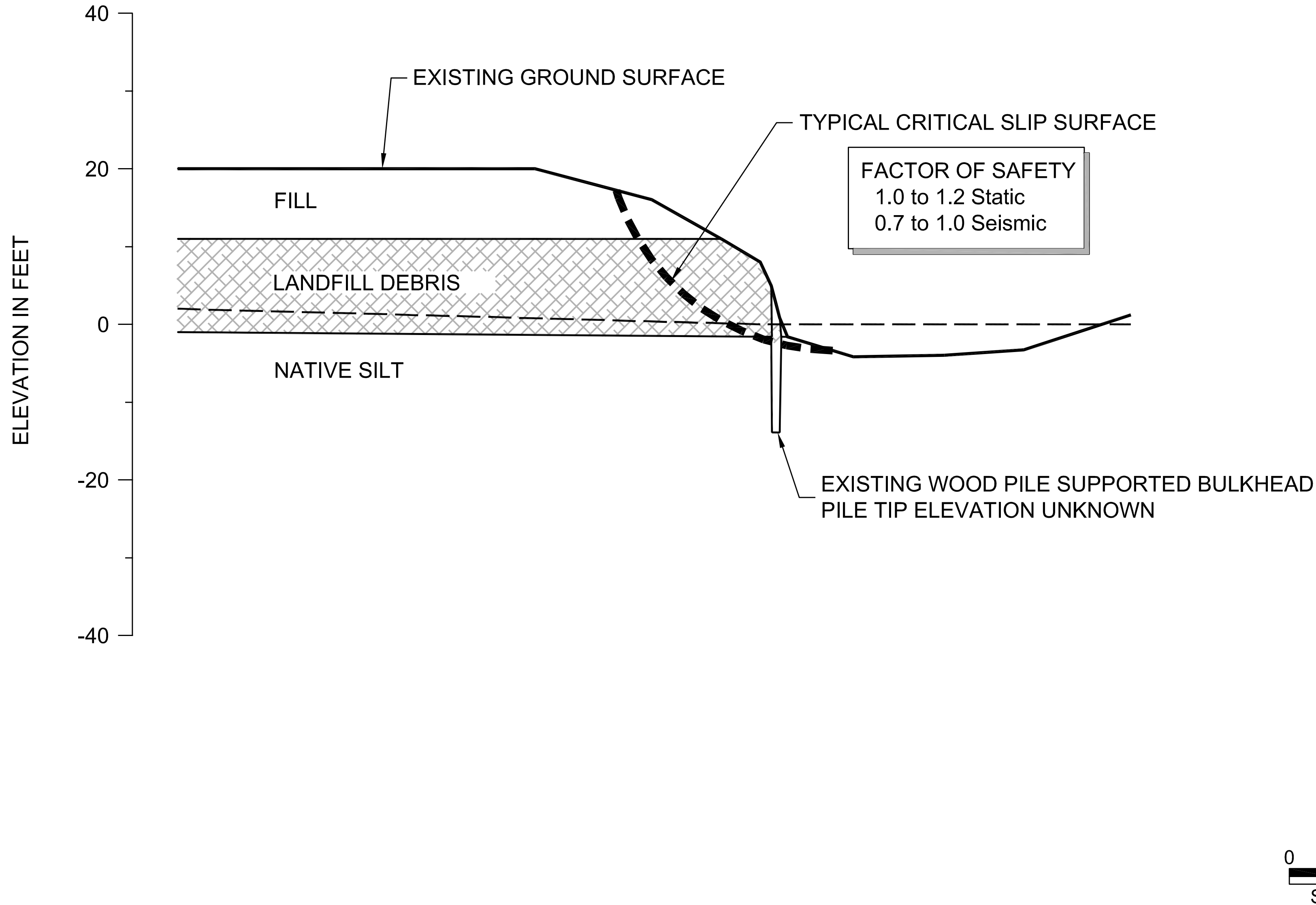

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Figure D-1
Slope Stability Section B-B
Existing Conditions

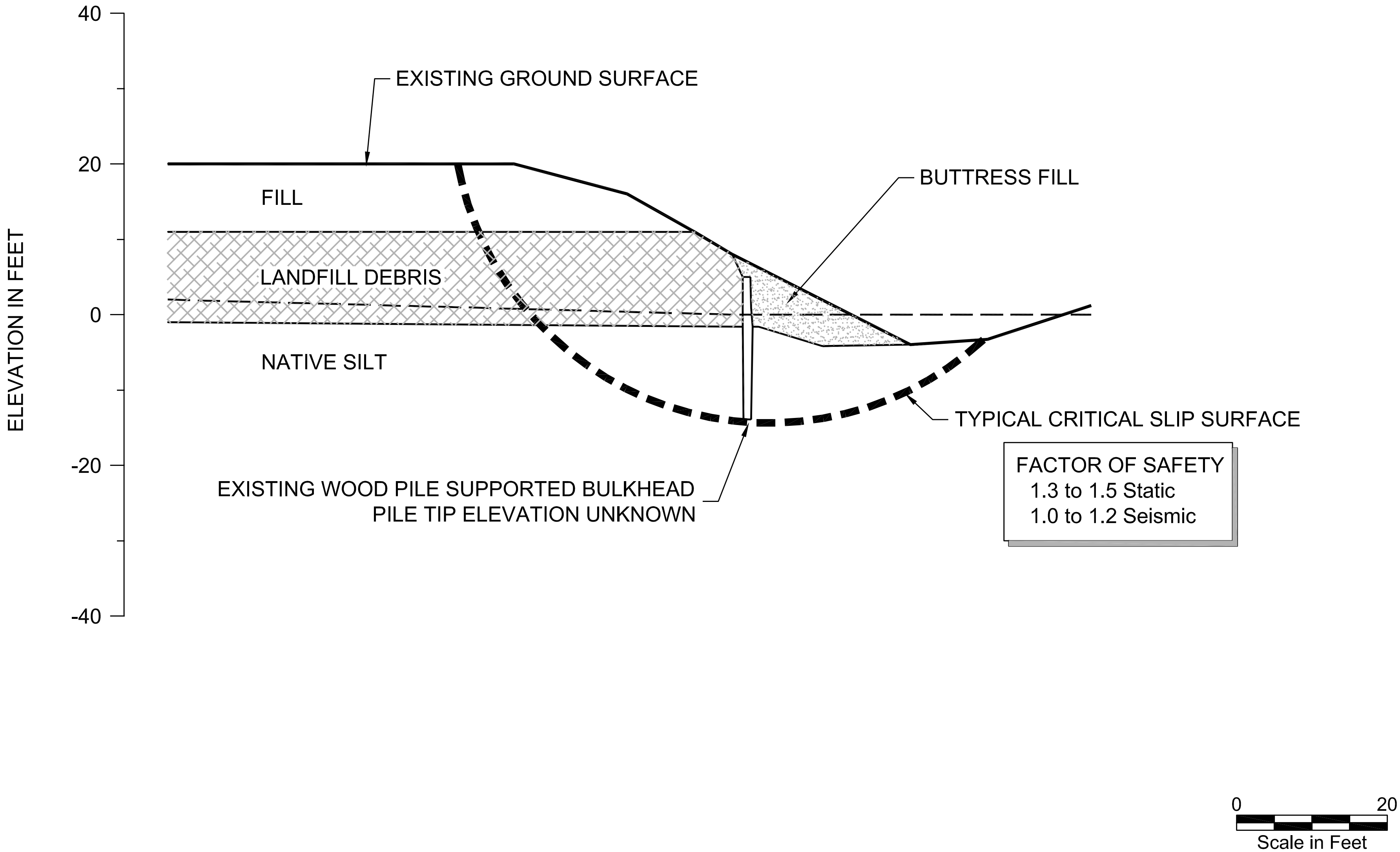

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Figure D-2
Slope Stability Section B-B
Proposed Buttress Fill

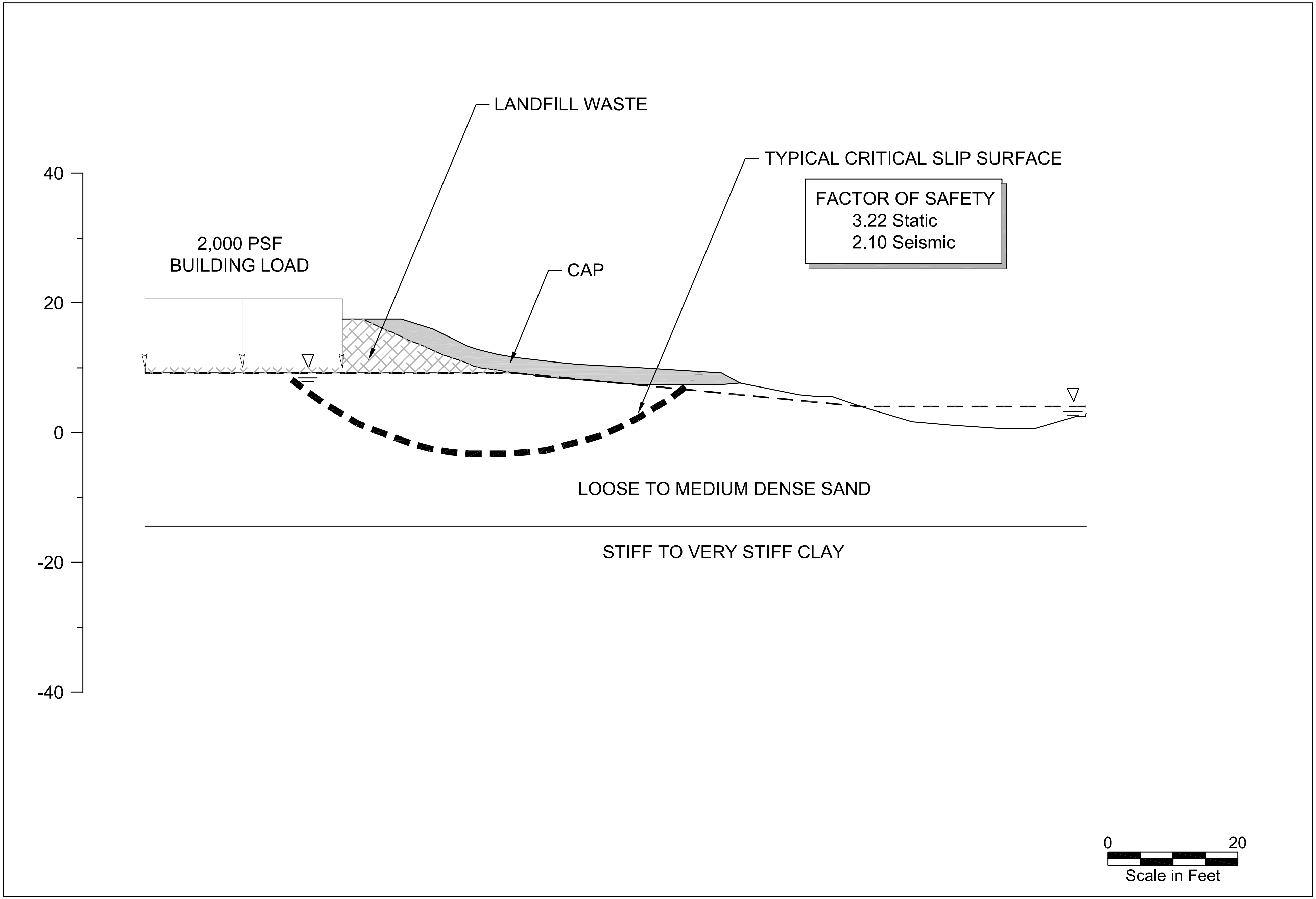

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Figure D-3
Slope Stability
Existing Re-Store Building

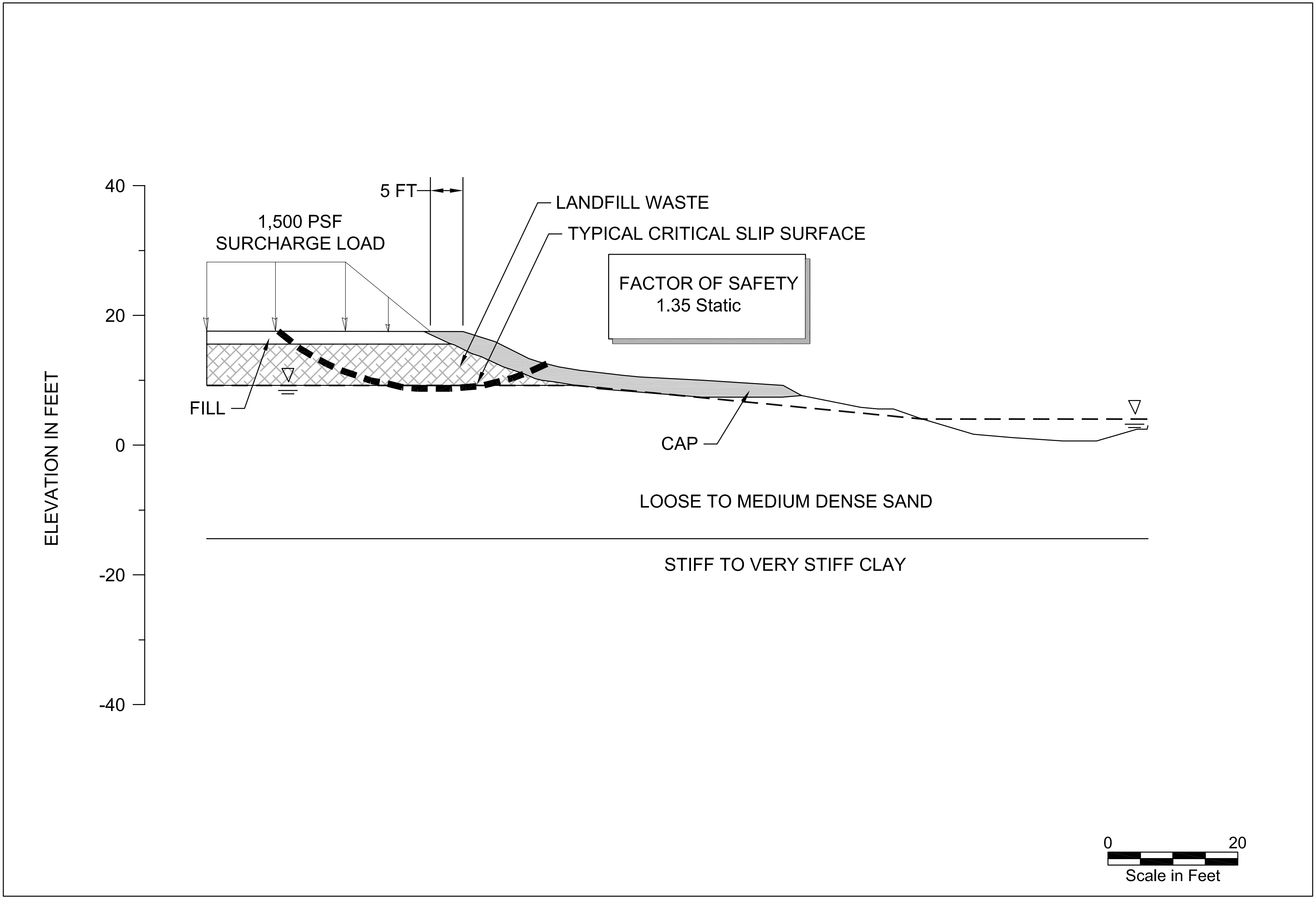

Figure D-4
Slope Stability
Construction Surcharge